Cardiac Examination: Relying on More than Just your Stethoscope

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Abstract

This presentation is intended to describe the methods and procedures for performing a complete cardiac examination, focusing on the non-auscultation aspects of the examination. Diagnosis of cardiac diseases will be covered, using ECG, patient images, and echocardiographic images. The presentation will describe aspects of abnormal cardiac examinations and describe the physiologic mechanisms that account for the findings.

Keywords: auscultation, jugular pulsation, thrill

Body Condition & Muscle Mass

Body condition scoring (BCS) is a commonly performed assessment in the routine physical examination of veterinary patients. This utilizes details about overall conditioning, such as ability to see / palpate ribs and dorsal processes of the spine, and more specific evaluations of muscle mass can be incorporated in these scores. Almost any chronic disease can cause poor body condition and progressive weight loss, and this is referred to as cardiac cachexia when caused by a chronic cardiac disease (congenital and acquired).

Although little diagnostic information is gained by observing that a dog or cat has poor body condition (i.e. it could be caused by a cardiac disease, or a systemic disease, etc.), this is an important aspect to the non-auscultation cardiac examination for the following reasons:

1) Some clinical signs such as lethargy, generalized weakness, or collapse can be explained by poor muscle mass that develops with cardiac cachexia. With this in mind, it may be of benefit to identify "at risk" patients (those with chronic cardiac diseases that are just beginning to lose weight and muscle mass) and recommend diet changes to prevent further decline.

2) Dogs and cats with congestive heart failure (CHF) have worse survival times when they present in CHF in poor body condition (BCS 4/9 or less) compared to dogs and cats with good (BCS 5/9) or obese (BCS > 5/9) body conditions. Knowing that animals with chronic heart disease have poor survivals if thin and may lose weight and muscle mass over time due to cardiac cachexia, it is important to prevent this loss as much as possible prior to the onset of CHF.

Mucous Membranes

Assessment of mucous membranes is an important part of all physical examinations. Although many diseases / conditions produce alterations in mucous membranes (i.e. many non-cardiac), this section will only discuss those that have relevance to cardiologic diseases.

1) Pale mucous membranes: This finding can be observed with anemia, as the percentage of red blood cells within the blood decreases (and so plasma percentage increases) which causes a pale coloration. Cardiac arrhythmias that decrease cardiac output (both tachyarrhythmias and bradyarrhythmias may decrease cardiac output) which therefore decrease perfusion to the blood vessels within the mucous membranes. Arrhythmia-induced pale mucous membranes are typically episodic and seen most commonly with very fast tachyarrhythmias (ventricular

tachycardias or supraventricular tachycardias with heart rates ~ 250 bpm or greater) or with bradyarrhythmias that have long pauses with no heart beats (such as with Sick Sinus Syndrome, when dogs may have no heart beats over a period of 6-12 seconds). Once the heart rate is normal again, the mucous membranes will be normal pink color again. This finding of transient pale mucous membranes should warrant investigation for an arrhythmia.

2) Tacky mucous membranes: This finding of dry mucous membranes is observed with many different diseases, but can indicate dehydration. Some dogs pant often while in the veterinary hospital, and this will cause the gums to be dry but may just affect this local environment (i.e. the dog may not be dehydrated, even though the panting has caused temporary tacky mucous membranes).

3) Hyperemic mucous membranes: This finding of dark red mucous membranes is observed with an increased hematocrit causing an increased percentage of red blood cells within the blood. Some dogs with right-to-left shunts develop polycythemia. The poorly oxygenated blood that gets into the systemic circulation interacts with the kidneys. This oxygen-poor blood stimulates the kidneys to release erythropoietin, which causes the bone marrow to produce more red blood cells. When hematocrits are very high (~65% or greater), the blood is too viscous to properly perfuse tissues and clinical signs such as collapse may develop. At this point, red blood cells need to be removed with therapeutic phlebotomy.

4) Cyanotic mucous membranes: This finding of blue/purple mucous membranes is observed with central cyanosis and differential cyanosis. Central cyanosis is when the entire systemic blood pool is poorly oxygenated. This may be observed with an intra-cardiac right-to-left shunt (i.e. ventricular septal defect, atrial septal defect, or Tetralogy of Fallot) or hypoxia (i.e.

pulmonary thromboembolism causing pulmonary hypertension, or lack of adequate O_2 intake such as when choking, with tracheal collapse, or when an endotracheal tube is inadvertently placed in the esophagus). Differential cyanosis describes when mucous membranes in the cranial half of the body are normal and pink colored, whereas mucous membranes in the caudal half of the body are cyanotic. This typically happens with a right-to-left shunt outside of the heart, typically with a right-to-left shunting patent ductus arteriosus. Some dogs are born with shunts such as a ventricular septal defect, atrial septal defect, or a patent ductus arteriosus that allow blood to move from left heart chambers (or systemic circulation) into the right heart chambers (or pulmonary circulation). Over time if the volume overload is significant, the pulmonary arteries reflexively vasoconstrict and this arterial endothelium and vascular smooth muscle develops pathologic changes with chronicity. These changes begin to increase the pulmonary arterial pressure (i.e. cause progressive pulmonary hypertension), and this process may continue until the pulmonary pressures are greater than the systemic pressures. Right heart pressures correlate with pulmonary arterial pressures. Once this occurs, blood moves from the right side of the heart (or pulmonary circulation) into the left heart chambers (or systemic circulation). Thus, what was originally a left-to-right shunt became a right-to-left shunt due to the development of severe (supra-systemic) pulmonary hypertension. This process is called Eisenmenger's Syndrome.

Femoral Pulse Evaluation

Evaluating the femoral pulses is a critical aspect to the cardiovascular examination. This should be performed while simultaneously auscultating the animal's heart (if small animal). There are several details to hone in on during femoral pulse assessment:

1) Femoral pulse strength: The pulse pressure is defined by the following formula:

$$Pulse\ Pressure = Systolic\ Pressure - Diastolic\ Pressure$$

The larger the quantity for pulse pressure, the stronger the pulse will feel during palpation. Diseases with reduced forward cardiac output (such as Dilated Cardiomyopathy, or Subaortic stenosis) will have a reduced systolic pressure, so the pulse pressure will be diminished (i.e. weak pulse). Diseases with a reduced diastolic pressure (such as left-to-right shunting patent ductus arteriosus or severe aortic regurgitation) will have a greater pulse pressure assuming systolic pressure does not change (i.e. hyperdynamic pulse).

2) Are femoral pulses synchronous with heartbeats? Each heartbeat should generate a femoral pulse. By simultaneously palpating femoral pulses and auscultating the heart, one can easily discern if a heartbeat occurs without a concurrent femoral pulse (i.e. "missed pulse" or drastically weakened pulse for one heartbeat). This may occur with premature heartbeats, both ventricular and supraventricular in origin. The premature timing of the beat causes a shortened diastolic filling time of the ventricles, which has reduced cardiac output for that beat.

Cardiac Impulse Palpation

In a normal dog, the cardiac impulse should be almost exclusively appreciated on the left hemithorax. The left ventricle of a normal dog has much more muscle mass than the right ventricle, and so it is easier to feel the heart beat on the wall of the left hemithorax compared to the right. While palpating both sides of the chest simultaneously, the impulse on the right hemithorax may not even be appreciated in a dog with a normal right ventricular size. When a dog develops right heart enlargement (either eccentric or concentric hypertrophy), the cardiac impulse on the right hemithorax can become as strong or stronger than the impulse on the left

hemithorax. Note: while palpating for the cardiac impulse, you can also appreciate whether or not there is a cardiac thrill (i.e. 5/6 murmur).

Jugular Vein Assessment

Observing for jugular venous distention and / or pulsation should be a routine part of every physical examination, or at the very least in patients with a suspicion of cardiac disease. The external jugular vein can be observed from the manubrium to its bifurcation into the linguofacial and maxillary veins. Normal dogs may have some pulsation of the jugular vein near the manubrium (no more than ~1/3 of the distance starting at the manubrium and ending at the bifurcation). Dogs with elevated right atrial pressure may have distention / pulsation observed more than ~1/2 this distance up towards the bifurcation of the jugular vein. The course of the right jugular vein has direct connection to the cranial vena cava, aligned in a straight line; however, the left jugular vein has a more curved connection to the cranial vena cava. This likely makes the translation of pressure from the right atrium / cranial vena cava easier to observe on the right jugular vein (i.e. it is easier to observe a dilated / pulsating jugular vein by observing the right external jugular vein).

Hepatojugular Reflux Test: This test is performed in combination with the jugular venous assessment. While observing the right external jugular vein, apply pressure to the cranial abdomen with a closed hand. Maintain this pressure during visual inspection of the jugular vein. By applying pressure to the cranial abdomen, the liver is somewhat compressed causing extra blood volume to travel from the liver into the right heart via the caudal vena cava. In dogs with normal right heart pressures, this extra blood volume will enter the right atrium and then right ventricle. Since normally the right atrium and ventricle are relatively compliant (i.e. can expand and take in extra volume without significantly increasing the chamber pressure), this extra blood

is received and there is no change to the right jugular vein. This is a normal result, AKA a negative hepatojugular reflux test result. In dogs with abnormally elevated right heart pressures, the extra blood volume enters the right atrium but cannot all enter the right ventricle. A right ventricle in or on the verge of heart failure has lost its compliance and is already stretched to its maximum size. The extra blood volume causes an increase in right atrial pressure, so some of this extra blood volume and the pressure it causes travel to the cranial vena cava and into the external jugular vein. While compressing the liver, you will observe the right jugular vein becoming more distended. Once the compression is released, the jugular vein will become less distended. This finding suggests the presence of significant right heart disease. This is a positive result, AKA a positive hepatojugular reflux test.

References

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